EXH. JPH-4
DOCKETS UE-240004/UG-240005
2024 PSE GENERAL RATE CASE
WITNESS: JAMES P. HOGAN

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND ENERGY,** **Respondent.**	**Docket UE-240004** **Docket UG-240005**

THIRD EXHIBIT (NONCONFIDENTIAL) TO THE PREFILED DIRECT TESTIMONY OF

JAMES P. HOGAN

ON BEHALF OF PUGET SOUND ENERGY

FEBRUARY 15, 2024

BAKER RIVER PROJECT
Board of Consultants Report for Meeting No. 6
Puget Sound Energy Conference Center, Snoqualmie, WA
12 - 14 December 2017

1. Introduction

This meeting of the Board of Consultants (Board) for the Baker River Project reviewed progress on the investigation programs and analyses for the Lower Baker Dam.

This Board report addresses questions posed by Puget Sound Energy (PSE) and FERC and responds based on the presentations made on Tuesday, Wednesday and Thursday December 12, 13 and 14, 2017 by PSE and their consultants.

2. PSE & FERC Questions and BOC Responses

2.1 PSE Question #1: Seepage

Through the investigation and subsequent studies/modeling conducted to date, has PSE characterized the site geology and hydrogeology sufficiently such that the following statements can be considered accurate?

a) Seepage through the dam foundation and both abutments is increasing with time.
b) Mitigation of the seepage is required to ensure dam safety.

Board Response

a) Yes. Seepage is increasing with time in a stepped fashion. It also appears that the steps are related to major flood events and the aftermath. The data are inconclusive regarding the rate of increase in seepage, although hydrogeological modeling suggests that erosion of joints in the rock mass should cause the rate of seepage to increase three times with a two times increase in discontinuity aperture (Reference 5).
b) Yes. It is our opinion that this is a dam safety issue. Firstly, under the dam, we have an unfiltered drainage system with a high hydraulic gradient and evidence of coarse material being transported (References 3, 4 & 5). If unmitigated, this could lead to the potential failure mode (PFM) N-LB-6, "foundation leakage, under normal pool destabilizes either rock abutment, leading to loss of arch support, dam failure, and release of the reservoir". In addition, this could lead to PFM N-LB-7; "foundation leakage leading to internal erosion underneath the dam resulting in uncontrollable increase in flow rate and release of the reservoir, though the dam may remain intact".

2.2 PSE Question #2: Grout Curtain

Through the investigations and subsequent studies/modelling conducted to date, has PSE characterized the site geology and hydrogeology sufficiently such that the following statements can be considered accurate?

a) A modern grout curtain is the most effective means of mitigating the seepage.
b) If designed and executed properly, the grout curtain will not introduce additional hazards to the dam or make the existing conditions worse.

Board Response

a) Yes. The 30% Design of the grout curtain, does represent the best of contemporary practice and so may be regarded as "modern" as used in the question. We concur with the outcome of the alternatives analysis (Reference 8) in that while other mitigation options e.g. cutoff wall or replacement dam are simply not viable, while a properly designed and implemented grout curtain is the most effective practical option.
b) This is a correct statement assuming that the curtain will be of the nature outlined in the 30% Design. We would observe however, that the nature of the site renders the construction of the curtain a relatively challenging task and further that transient impacts on the foundation may well result from the drilling and grouting activities. We do not believe that such transients would be of an intensity or magnitude to create a dam safety issue. We would also anticipate that a very strong environmental protection program would have to be designed and implemented given the likely hydraulic connection between the grouting and the River. As a final point, the current concept to procure a contractor on the "best-value" basis and the implementation of "Early Contractor Input" (ECI) concepts will certainly help manage the construction, environmental and interim dam safety risks.

2.3 PSE Question #3: Forebay Depression Works

Through the investigations and subsequent studies/modelling conducted to date, has PSE characterized the site geology and hydrogeology sufficiently such that the following statements can be considered accurate?

a) Attempting to reduce the velocity of the seepage under the dam by filling the forebay depression with aggregate, low mobility grout, or similar medium will not introduce additional hazards to the dam.
b) Attempting to reduce the velocity of the seepage under the dam by filling the forebay depression with aggregate, low mobility grout, or similar medium may reduce the challenges of installing a grout curtain.

Board Response

a) Yes. Our only concern would relate to the possibility that the materials placed would in some way prove a challenge to the drilling activities for the grout curtain or the efficiency of the horizontal seal between the grout curtain and face of the dam. See Figure 1 for a sketch of a potential leakage path.
b) Yes. Any intervention to reduce the velocity of the seepage prior to and during grouting will increase the likelihood of successfully constructing the curtain to satisfy design requirements (i.e. residual permeability of the grouted mass).

In answering both of these questions, we note that cementitious materials are now not intended to be used during the filling of the forebay depression and that, in effect, a reverse filter concept will be implemented.

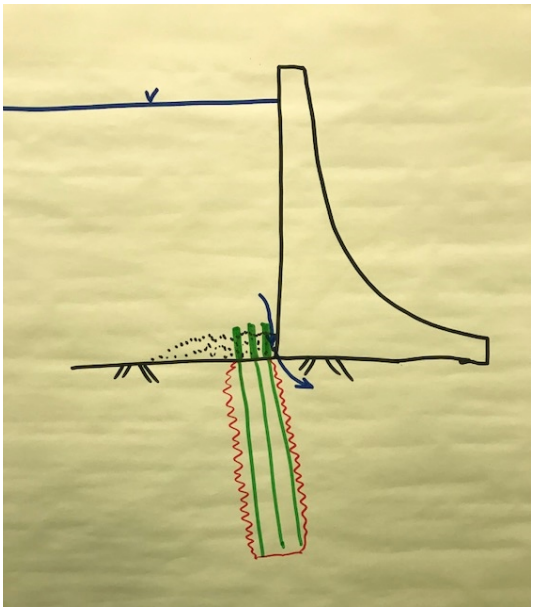

Figure 1 Potential Leakage Path

2.4 PSE Question #4: Slope Stability Issues

Through the investigations and subsequent studies/modelling conducted to date, has PSE characterized the site geology and hydrogeology sufficiently such that the following statements can be considered accurate?

a) Slope stability improvement recommendations or monitoring programs are adequate.
b) Slope stability improvement recommendations or monitoring programs will not introduce any new hazards to the dam or make the existing conditions worse.

Board Response

a) Yes. The S&W Team has recommended performing periodic LiDAR surveys to monitor and record the amount and intensity of rockfall experienced from the canyon walls downstream of the dam (Reference 7). This is an effective means to monitor rockfall and proactively identify areas where rockfall may be indicative of some other, larger PFM (to be determined). With regards to PFMs N-LB-2, F-LB-2, and S-LB-2, the S&W Team has not conclusively identified acceptable factors of safety against block sliding of the "Left Abutment Block" (the wedge defined by SH2 and C6) downstream of the dam (Reference 7). Their preliminary block stability evaluation shows that depressurizing the rock mass behind SH2 would be an effective mitigation measure to increase the Left Abutment Block stability. The Team has also proposed the installation of a series of geotechnical borings instrumented with piezometers to better characterize the geologic structure and groundwater conditions behind the Left Abutment Block and within the East (Structural) Block. The piezometers can also monitor the effectiveness of any depressurization schemes implemented with the collateral benefit of being part of a larger monitoring program for measuring the effectiveness of the grout curtain during and after construction. We concur that depressurization of the rock mass behind SH2 would be an effective means to increase the Left Abutment Block stability and that the installation of the (yet to be proposed) piezometers would provide verification of effectiveness of any depressurization schemes that may be adopted for this purpose.
b) Yes. We don't foresee that the scope referred to in the answer to a), above will introduce any new hazards or make existing conditions worse provided that proper safe drilling techniques are utilized, e.g. for installation of drains.

2.5 PSE Question #5: Structural and Seismic Issues

a) Does the Board concur with PSE's intent to conduct all further structural modeling of the dam based on the proposed conditions associated with the Lower Baker Dam Crest Improvement Project?

b) Does the Board concur with PSE's intent to evaluate the structural stability of the dam based on the MCS's 84% response spectrum of a random crustal event as outlined in the United States Army Corps of Engineers draft guidance?

Board Comments

a) Yes. The Board concurs with PSE's plan for structural modelling to be based on the conditions expected after completion of the Lower Baker Dam Crest Improvement Project. Since the improved project will retain a higher reservoir elevation, the loadings will be more demanding than the existing conditions.

b) Yes. The Board concurs with PSE's intent and supports the following approach:

- The seismically-initiated PFMs should be identified for the dam body, abutments, spillway, gates and associated equipment and form the basis of the seismic analyses.
- Dam body PFMs should address failure within the arch-gravity section, possibly a "Smiley Face" mode, or other credible failure mode. The interaction of the dam body and abutments should be considered.
- PFMs for the new spillway piers and gates should consider whether the piers and or gates may fail allowing uncontrolled discharge through the spillway openings, or whether the gates jam and cannot be operated as required to manage floods.
- Analyses of PFMs that may lead to a dam breach and present a life safety risk should be based on the controlling deterministic "Maximum Credible Earthquake" (MCE) which was identified by Hatch (Reference 6) as the random Mw 6.5 shallow crustal event. The 84-percentile response spectrum for this event should be used as the basis for selection of time histories for analyses.
- Analyses and design for PFMs for the piers and/or gates that will not lead to a dam breach or life safety risk may be based on response spectra for an "Operating Basis Earthquake" (OBE) of lesser magnitude and return period than the MCE. The selected OBE, analyses and design should use criteria consistent with the desired post-earthquake operability requirements.
- The Board notes that current FERC concrete gravity dam guidelines do not presently specify performance criteria during the passage of the earthquake ground motions but do require the demonstration of stability in the post-earthquake condition which includes consideration of any damage incurred during the event. The analyses proposed by PSE will provide useful information for assessment of the structural performance during the event and provide a basis for the required post-earthquake analyses.

2.6 FERC Question: Geologic Model

a) Has the geologic model been completed as the BOC asked?
b) What do we need to do to make sure (documentation-wise) that this geologic model is usable in 15 or 20 years?

Board Response

a) Yes. The model is complete with respect to the information that is available to date. We understand and expect that the model will be a 'living-document' that will be updated as further information becomes available from further geological characterization and with the data collected during construction of the grout curtain and any other remediation activities.
b) Documentation of the geologic model should consist of:
    - Hard copies of every report upon which the model is based,
    - Hard copies of a series of closely-spaced geologic sections perpendicular and parallel to the axis of the dam,
    - Model object coordinates output in spreadsheet format for importing into other software modeling programs, and

    Full details of the documentation should be designed by an IT/Archivist.

3. Board of Consultants Recommendations Log

The Board of Consultants Recommendations Log was updated during our meeting by incorporating verbal input. We have reviewed the updated log of 12/14/2017 and agree with the proposed actions for all on-going itemized items.

The Board suggests that the Log is updated prior to subsequent meetings and reviewed at an early stage of each meeting. It may be helpful to sort the items so the "ongoing" items are brought to the beginning of the Log to facilitate focus on key issues. If they are re arranged, the completed items should be retained.

4. Concluding Remarks

The Board compliments PSE and their consultants for a well-organized meeting, excellent presentations, and constructive discussions and hopes that these remarks will be of assistance to PSE in moving forward.

The next Board Meeting will be arranged to correspond to the next key milestones, date to be confirmed.

Submitted by:



Robin G. Charlwood | Donald A. Bruce | Brendan R. Fisher

December 15, 2017
Attachments: Agenda; List of Attendees.

5. References

1. HDR Engineering, Inc. (2014). Baker River Hydroelectric Project Lower Baker Development, FERC Project No. 2150. Potential Failure Modes Analysis Report. November 2014.

2. Duron, Z. h., Lie, K., Gelber, M., Gardner, C., and Fellow, D. P. (2017). Performance Based Testing and Analysis of Foundation Interaction Effects at Lower Baker Dam.

3. GeoHydros, LLC. (2017a). Numerical Simulation of Leakage at the Lower Baker Dam near Concrete, Washington Using a Hybrid Groundwater Flow Model. November 1, 2017.

4. GeoHydros, LLC. (2017b). Results of the 2017 Forebay and Boreholes Dye Tracing Studies at Lower Baker Dam, Concrete Washington. November 3, 2017.

5. GeoHydros, LLC (2017c). Seepage Model Structure and Seepage Data Compilation. December 13, 2017.

6. Hatch (2017). Selection of Earthquake Ground Motion Levels for Seismic Assessment of Lower Baker Dam. August 25, 2017.

7. Shannon & Wilson (2017a). Rock Mass Failure Modes, Lower Baker Dam. Report No. 21-1-22284-004. November 7, 2017.

8. Shannon & Wilson (2017b). Seepage Reduction Alternatives, Lower Baker Dam, Concrete, Washington. Report No. 21-1-22284-005. November 9, 2017.

9. Shannon & Wilson (2017c). Quality Assurance/Quality Control of the 2015 Geotechnical Data Report Lower Baker Dam Concrete, Washington. Volumes 1 through 5. Report No. 21-1-22284-001. November 13, 2017.

10. Shannon & Wilson (2017d). Baker River Project Updated Deterministic Seismic Hazard Analysis, Concrete, Washington. Report No. 21-1-22284-004. November 15, 2017.

11. Terrain Geosciences, Inc. (2017). Lower Baker Dam – Structural Geology Review. November 5, 2017.

12. Tetra Tech (2017). Geologic Interpretation and 3-D Model Development - Lower Baker Dam. November 2017.

Tuesday, December 12th, 2017

Meeting Location:
PSE Snoqualmie Conference Center
35413 SE Douglas St
Snoqualmie, WA 98065

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Or, call in using your telephone (1-240-454-0879).
Meeting number/access code: 800 653 455

No.	Time	Agenda Item	Reference Documents ** Denotes BOC meeting documents submitted for review & reference*	Presenter
	7:30AM	**Coffee**		
1	0800-0830	Introductions, Meeting Logistics, Safety Minute, and Discussion of Meeting Objectives		Danielson
2	0830-0900	GDR		Hultman
3	0900-0930	GDR QA/QC	** Memorandum Task 1 – Quality Assurance/Quality Control of the 2015 Geotechnical Data Report, Lower Baker Dam, Concrete, Washington*	Hultman
15 min.		**Break**		
4	0945-1200	Geologic Model	** Geological Interpretation and 3D Model Development – Lower Baker Dam, Concrete, WA*	Bartsch
12:00-13:00		**Lunch Break**		
5	1300-1330	Geologic Model QA/QC	** Lower Baker Dam – Structural Geology Review*	Kruse
6	1330-1530	FEFLOW	** Numerical Simulation of Leakage at the Lower Baker Dam near Concrete, Washington Using a Hybrid Groundwater Flow Model*	Kincaid
15 min.		**Break**		
7	1545-1700	Dye Testing	** Results of the 2017 Borehole Dye Tracing Studies at the Lower Baker Dam, Concrete, WA*	Kincaid
8	1700-1715	Daily Recap/Wrap-up		Danielson

Wednesday, December 13th, 2017

Meeting Location:
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35413 SE Douglas St
Snoqualmie, WA 98065

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Meeting number/access code: 800 653 455

No.	Time	Agenda Item	BOC Reference Documents ** Denotes BOC meeting documents submitted for review & reference*	Presenter
	7:30AM	**Coffee**		
9	0800-0815	Meeting Logistics and Safety Minute		Danielson
10	0815-0915	Pathways/Abutment Erodibility		Kincaid
15 min.		**Break**		
11	0930-1030	Pathways/Abutment Erodibility		Kincaid
12	1030-1200	Seepage Mitigation Alternatives	** Seepage Reduction Alternatives, Lower Baker Dam, Concrete, Washington*	Boyle
12:00-1:00PM		**Lunch Break**		
13	1300-1500	Rock Block Stability and PFMAs	** Rock Mass Failure Modes, Lower Baker Dam*	Whistler
15 min.		**Break**		
14	1515-1600	Seismic Memorandum	** Seismic Design Criteria Report*	Curtis
15	1600-1730	Structural Modeling Update		Curtis
16	1739-1745	Daily Recap/Wrap-up		Danielson

Thursday, December 14th, 2017

Meeting Location:
PSE Snoqualmie Conference Center
35413 SE Douglas St
Snoqualmie, WA 98065

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Or, call in using your telephone (1-240-454-0879).
Meeting number/access code: 800 653 455

No.	Time	Agenda Item	BOC Reference Documents ** Denotes BOC meeting documents submitted for review & reference*	Presenter
	7:30AM	**Coffee**		
17	0800-0815	Meeting Logistics and Safety Minute		Danielson
18	0815-0900	Review implementation plan options		Danielson/ Hultman
18	0900-1000	BOC Recommendations Log	** BOC Recommendations Log – Lower Baker*	Danielson
	Break			
20	1030-1530	BOC Report Drafting & Editing	BOC Draft Report	BOC
21	1600-1630	BOC Report Reading	BOC Draft Report	BOC
22	1630	Meeting Adjourned		

Board of Consultants Meeting No. 6 - Attendance - December 12 to 14, 2017

Attendee	Company/Agency	Attendance			
		Tues	Weds	Thurs am	Thurs pm
Bartsch, Cameron	Terrane Geoscience Inc.	X	X	X	
Bensko, Kathy	Federal Energy Regulatory Commission	X	X	X	X
Blanton, Matthew	Puget Sound Energy	X	X		
Boyle, Stan	Shannon & Wilson Inc.		X		
Brand, Bruce	Federal Energy Regulatory Commission	X	X	X	X
Bruce, Donald	Geosystems, L.P.	X	X	X	X
Carson, Katie	Federal Energy Regulatory Commission				WebX
Chandler, John	Puget Sound Energy	X	X		
Charlwood, Robin	Robin Charlwood & Associates, PLLC	X	X	X	X
Curtis, Dan	Hatch	X	X	X	
Danielson, Thomas	Puget Sound Energy	X	X	X	X
Dbaibo, Nabil	Puget Sound Energy	X	X	X	
Decker, Miriam	Puget Sound Energy				WebX
Fisher, Brendan	Fisher Rock Engineering, LLC	X	X	X	X
Gile, Joshua	Puget Sound Energy	X	X		X
Hultman, Will	Shannon & Wilson Inc.	X	X	X	WebX
Humphrey, Chris	Federal Energy Regulatory Commission	X	X	X	WebX
Johnson, Doug	Federal Energy Regulatory Commission	X	X	X	WebX
Kincaid, Todd	GeoHydros, LLC	X	X	X	
Kruse, Stefan	Terrane Geoscience Inc.	X	X	X	
Likavec, Michael	Puget Sound Energy	X	X	X	X
Lord, David	Federal Energy Regulatory Commission	X	X	X	
Netik, Irena	Puget Sound Energy	X	X		WebX
Nuss, Larry	Nuss Engineering, LLC	X	X	X	
Romocki, Robert	Puget Sound Energy	X	X	X	X
Sooch, Gurinderbir	Hatch	X	X	X	
Whistler, Rex	Shannon & Wilson Inc.	X	X	X	WebX